

**Review Report  
of the  
Laboratory Oversight Group  
following their  
Cost and Technical Status Review  
of the  
Rare Symmetry Violations Processes Project**

**January 18-20, 2005**

**at  
Brookhaven National Laboratory  
Upton, New York**

**Date of the Report February 23, 2005**

## Executive Summary

A Laboratory Oversight Group (LOG) Cost and Technical Status Review of the Rare Symmetry Violating Processes (RSVP) Project was held at Brookhaven National Laboratory on January 18-20, 2005 at the request of the RSVP Project Director. The Review was held in support of the Brookhaven National Laboratory (BNL) oversight role for the project and to provide advice and support to the RSVP Project Director as required in the “Memorandum of Understanding Between the National Science Foundation and the Department of Energy Regarding the Rare Symmetry Violating Processes (RSVP) Project – July 2004”. The focus of this review was a LOG assessment of the technical, cost and schedule status of the RSVP Project. The report is submitted to the RSVP Project Director and Deputy. Information copies of the report are provided to the NSF Physics Division, to the DOE Office of Nuclear Physics and to the DOE Brookhaven Site Office.

The Agenda for the review is provided as Appendix A of this report and the Charge to the LOG as Appendix B. In general, the review topic presenters followed the Charge and their presented material was discussed by the LOG members who provide their detailed findings, comments and recommendations in the body of this report. In this executive summary, the LOG provides high-level observations and recommendations to the RSVP Project Director and Deputy.

In the Charge, the managers of the RSVP Project were asked to fill in and provide to the LOG, a complete set of Review Status Sheets at Work Breakdown Structure (WBS) Level-2 (1.x.y) to facilitate the review’s focus on cost estimate maturity and technical readiness to proceed to construction. Presenters were also encouraged to provide additional information to clarify the current status of their project elements. In general, this approach was followed and the detailed sections of the report assess and comment on the material provided and presented.

The key purpose of this review was to assess the maturity and completeness of the RSVP Project cost estimate as well as its technical design maturity and the Project’s readiness to commence construction. At the summary level, the LOG found that:

- all three RSVP Project elements (K0PI0 Experiment, MECO Experiment and AGS Project upgrades) had well developed conceptual technical designs that would meet the experiments’ performance specifications;
- the AGS Project and the MECO Magnet sub-project demonstrated mature cost estimates; the K0PI0 and MECO cost estimates, as presented, were uneven and less mature;
- the K0PI0, MECO and AGS technical designs can yield beneficial cost reductions from further cost scrubbing and, in some areas, from careful scope reduction;
- the integrated RSVP Project Management structure provides opportunities for efficiencies and significant cost reductions in overall staffing levels;
- the *full-scope, NSF funded portion of the RSVP Project Cost Estimate*, as presented to the LOG, added up to a total of \$261.2M (FY05\$), not including funding contributions of \$19.1M, from the U.S. base program, Canadian and Japanese sources; the LOG believes this estimate could be reduced by \$10M with recommended economies; another \$50M of savings is potentially realizable through vigorous cost scrubbing and careful scope reduction.

The outcome in bullet-2 clearly resulted from the scarcity of engineering resources available to the K0PI0 and MECO projects that were needed to convert the conceptual designs of the experiments into reliable cost estimates. The presenters employed a Project Office-provided contingency

estimating algorithm (used successfully by the U.S. ATLAS Project) to compensate for the absence of engineer-developed cost estimating input. The LOG found that some of the contingency amounts applied were probably underestimated. Although some attempts were made to assess the resource-loaded schedule planning, the LOG determined that this aspect of planning was not ready for detailed review at this time. On the other hand, the projected construction period of 5-6 years should be adequate for the project to complete construction if not limited by rate-of-funding constraints.

In bullet 3, the LOG observes that KOPIO presented a de-scoping scenario that could provide substantial cost savings. KOPIO claimed that this de-scoping scenario has little impact on the experiments scientific program. Such savings will approximately restore the KOPIO cost estimate to its earlier anticipated level. The LOG urges RSVP management to pursue this cost savings opportunity. Cost savings opportunities should also be sought in the AGS and MECO projects, where identifying the possibilities will require detailed investigation of the technical elements by RSVP management, a level of scrubbing and de-scoping that could not be pursued by the LOG in this review venue.

In bullet 4, the LOG notes that the Project Office management structure was created to accommodate certain historical aspects of the RSVP Project evolution and the LOG believes that a streamlined management structure could yield significant cost savings.

In bullet 5, the LOG reports its conclusions about the cost estimate and its views about opportunities to reduce the large cost growth experienced by RSVP since the last bottoms-up estimate in 2001.

The LOG next provides specific, high-level comments and general recommendations on the substance of our review findings on the RSVP project elements. In the body of the report, the details that give rise to the general recommendations are provided, along with additional, lower-level comments and recommendations.

Comment 1: The LOG has identified areas in the AGS, KOPIO and MECO Projects that could yield significant potential cost savings from vigorous cost scrubbing as well as from careful and judicious scope reductions. Recommendations 1 and 2 address this item.

Comment 2: The AGS project and the MECO solenoids, representing over \$100M of project funds, appear to be well understood with appropriate costs and contingencies. Most of the remaining systems in the experiments have not received engineer-developed cost estimates and, in most cases, are likely to require larger contingencies than have been allocated so far. Recommendation 3 addresses this item.

Comment 3: The RSVP projects (KOPIO, MECO, and AGS) have reasonable conceptual designs and are ready to enter the technical design phase as soon as funding is available to support significant engineering activities. Recommendation 4 addresses this item.

Comment 4: The committee notes the new RSVP integrated management structure and believes that this structure, properly honed, can provide substantial benefits to the project. Recommendation 5 addresses this item.

With these observations and comments in mind, the LOG offers the following general recommendations to RSVP management.

**General Recommendations:**

1. *The LOG recommends that RSVP management immediately undertake a systematic cost and scope review of the K0PI0, MECO and AGS Projects with the goal of generating significant cost savings through vigorous cost scrubbing plus careful and judicious scope reductions.*
2. *The LOG recommends that immediately after the de-scoping exercise, the four projects create both a TDR and a bottoms-up, resource-loaded, linked WBS as rapidly as possible. The goal is to establish a reliable baseline cost estimate*
3. *The LOG recommends that Project Management re-examine the contingencies of the project elements that are not yet engineered and adjust the contingencies to levels appropriate for un- or incompletely engineered systems.*
4. *The LOG recommends that management implement economies of scale in common resources for all four projects.*
5. *The LOG recommends that project management carefully examine the streamlining and consolidation of project offices; the goal is to apply valuable and scarce engineering resources to the short-term technical needs of the experiments.*

LOG members attending this review comprised: Dr. Thomas Kirk (Chair), BNL; Prof. Senta Victoria Greene, Vanderbilt Univ.; Dr. Edward O'Brien, BNL; Dr. Ronald Ray Jr., Fermilab; Prof. Kenneth Ragan, McGill Univ.; and Dr. Alexander Zlobin, Fermilab. No LOG members were absent. Dr. Marvin Goldberg, NSF RSVP Program Officer, Dr. James Hawkins, DOE Office of Nuclear Physics Program Officer, Dr. Nand Narain, DOE Site Office scientist and Mr. Michael Butler, DOE Site Office Federal Project Manager attended the review as observers.

This report and its recommendations is concurred in by all members of the Laboratory Oversight Group.

## **Main Report**

The main review report of the Laboratory Oversight Group (LOG) is provided here. The committee first makes some general observations and a recommendation on the important topic of cost estimate growth in the RSVP Project and then provides a complete report on the LOG review of the elements of the project with findings, comments and recommendations.

### **General Issue: Cost Estimate Growth in the RSVP Project**

Before presenting the detailed report of the Laboratory Oversight Group (LOG), the LOG felt that it should comment on a topic of over-riding importance for the future of the RSVP Project. This is the issue of large growth in the cost estimate for the project that has occurred during the period since the last bottoms-up review of the RSVP project costs in 2001. Since that time, the K0PI0 and MECO Collaborations have pursued detector systems R&D and physics simulations to refine the conceptual basis for the two experiments. Both experiments have also sought AGS accelerator test time to verify important accelerator performance assumptions that are critical to success. In addition, the MECO Collaboration pursued a professional conceptual design study of the MECO Magnet System through the MIT Plasma Science and Fusion Center. This study was successfully completed and forms the basis of a reliable cost estimate for the costly MECO magnet system.

Good progress was made on all these RSVP activity fronts, but the detailed cost estimates for the detector systems and for the AGS-related accelerator and beamline elements of the two experiments were not able to be effectively pursued in parallel with the technical developments. This was due to a lack of funding for the engineering efforts needed to turn the evolving conceptual designs into reliable cost estimates. Also, on January 27-28, 2004, at the request of the U.S. Department of Energy (DOE) Office of Nuclear Physics, Mr. Daniel Lehman of DOE chaired a comprehensive review of the potential negative impacts of the RSVP project and its data taking operations on the DOE's Relativistic Heavy Ion Collider (RHIC) program now operating at BNL. The review report concluded that there were no negative impacts incurred by the planned RSVP program. No bottoms-up RSVP cost estimate review was performed from 2001 through 2004. This history of conceptual technical progress without comparable cost estimate tracking set the stage for the large cost estimate growth seen in the LOG review.

This was the situation when the NSF and the DOE completed and signed a Memorandum of Understanding (MOU) in July 2004 and NSF subsequently appointed the RSVP Project Director, Prof. William Willis of Columbia University, and Deputy, Dr. Jonathan Kotcher of BNL. Following these management actions by the agencies in summer 2004, the Project Director and Deputy mobilized the three RSVP project managers under the new, MOU-delineated RSVP project management and agency oversight structure. The new RSVP Work Breakdown Structure (WBS) broke out the AGS Project from the K0PI0 and MECO Projects, giving it a separate project designation, WBS structure and cost estimate. This new structure will now be followed in all project activities. The new structure was employed in preparing a bottoms-up RSVP project cost estimate during the fall and early winter of 2004-2005. The LOG Review of January 18-20, 2005 became the first occasion when all the elements of the 2004 complete RSVP project cost estimate were reviewed by a committee of experts. The LOG review committee was presented with a very large cost estimate growth over the 2001 (inflation-adjusted) exercise, one that reflected several important changes. The major cost growth items were:

1. The MECO Magnet Design Report plus expert cost and technical reviews increased the magnet system cost estimate from about \$30M to \$55M.
2. Provision for extensive radiation-damage mitigation and environmental protection measures for the Booster and AGS accelerator systems, driven by the NSF-DOE MOU policy that RHIC had to be fully protected against loss of operations time resulting from RSVP-induced equipment failures; this requirement imposed new costs of about \$20M.
3. The K0PI0 conceptual design has grown in geometrical size, scaled by the inner diameter of the large decay vacuum vessel which grew from the 2001 design radius of 2.5m to 3.2m; the ramifications of this scope increase approximately doubled the detector cost estimate (NSF portion) from \$56M to \$103M.
4. Other project elements, exclusive of the MECO magnet System and the K0PI0 scope growth, have also grown through maturation of the conceptual design and the application of a more systematic contingency estimating algorithm, for a net increase of about \$24M over the January 2004 estimate.

These cost growth items have raised the total from the FY2004 NSF request for the RSVP MRE-FC Project of \$145M to the current full-scope NSF MRE-FC budget estimate of \$261M (FY05\$). There was a modest included contribution from inflation but this was not significant on the scale of the major growth items noted above.

With these circumstances in hand, and mindful of the very tight budgets that are expected to be imposed on NSF science projects over the years ahead, the LOG supports the RSVP Project Office in its determination to review and carefully reduce the RSVP project scope, especially the scope of the K0PI0 Project, and then vigorously scrub the down-scoped project cost estimates. Based upon the technical and cost estimate material presented to the LOG, the committee believes that this action can be accomplished without seriously damaging the capability of either K0PI0 or MECO to accomplish their scientific mission goals. To this end, the LOG proposes the recommendation below and also presents it as a General Recommendation in the Executive Summary of the report.

**Recommendation:**

1. *The LOG recommends that RSVP management immediately undertake a systematic cost and scope review of the K0PI0, MECO and AGS Projects with the goal of generating significant cost savings through vigorous cost scrubbing plus careful and judicious scope reductions.*

## **WBS 1.1 Project Office and Management**

**Findings:**

Dr. Jon Kotcher, RSVP Deputy Project Director, presented the Project Office and Management approach to RSVP. Speaking first to the management aspects of his presentation, he noted as the primary goals of the Project Office this year, an aggressive series of reviews designed to accelerate project readiness and the preparation of a full project plan with a resource-loaded schedule. The Project Office is working towards a May 2005 submission to NSF of a comprehensive project report. He also showed the LOG a schedule of 13 milestones with reviews that will accomplish this objective. He noted that RSVP is using Microsoft Project and Access tools for all project planning

and tracking throughout the RSVP Project. These project tools were used successfully in the U.S. ATLAS Project just being completed at BNL and are familiar to RSVP top management.

By way of moving towards a complete project management schedule, the three project managers of the K0PI0, MECO and AGS Projects have been told to "...construct schedules without regard to anticipated funding or resource availability: Tell us what you need." This action provides a technically limited project schedule that can serve as a baseline estimate for the project evolution. The three project managers, in their presentations, had not gone very far in developing resource-loaded schedules to respond to this planning guidance but all seemed to have confidence that they could carry out their projects in the allotted five years of construction, provided they were not inhibited by funding constraints.

Plans for providing funding from NSF to the various project partners are based upon a cooperative agreement on RSVP between NSF and Columbia University, at the completion of which, funding would pass from NSF to Columbia and on to BNL through a single contract between Columbia and BNL. All funding to the project partners would then be distributed by BNL to participating institutions via BNL sub-contracts. Jon Kotcher seemed confident this arrangement would work satisfactorily in spite of very long contract delays already experienced by BNL in pre-project NSF funding intended to go to BNL in recent years.

Kotcher then addressed the WBS 1.1 'RSVP Project Office' project elements:

#### 1.1.1 RSVP Project Services - Columbia

#### 1.1.2 RSVP Project Services - BNL

WBS 1.1 RSVP Project Office has a current total construction cost estimate (FY05 \$M) of \$19.8M with an included contingency of \$4.6M (30.0%). By way of describing the content of WBS 1.1, plus associated RSVP project office structure under the RSVP Project Office, Kotcher noted that there were three projects identified in RSVP, a departure from the usual structure of sub-projects grouped under a single Project Office. The RSVP Project is managed by two RSVP Project Offices, one at BNL and one at Columbia University. These two offices will be staffed with the project director and deputy, two half-time senior advisors (Tom Taylor, Chair of the MECO Magnet Oversight Group and Alex Firestone, advisory support), one senior project engineer, plus three full-time budget/schedulers, 1.25 FTE of procurement, safety, quality assurance and document control effort and two full-time administrative support persons. Assistance from the BNL Physics Department Office staff was also identified. This staff will accomplish scheduling, project tracking, reporting, reviews and financial administration, plus safety, quality assurance, document control and some aspects of procurement. It appears that the two RSVP project offices will have, in total, about 10 FTE of staffing. The K0PI0, MECO and AGS Projects will also each have a project office (under its own project WBS structure) with a project manager, plus administrative and technical oversight staff at the level of 0.5-4.0 FTE. In the K0PI0, MECO and AGS presentations, these three project offices will have another 5, 3 and 1.8 FTE, respectively. The total base cost of the five project offices is \$28M for five years of construction. In general, each office identified another 20% or so for a contingent sixth year of operations, raising the cost plus contingency to \$35M. Jon Kotcher stated that the overall staffing levels have been agreed to by NSF. The description of the RSVP Project Office and its budget basis was clearly presented and understandable to the LOG.

#### **Comments:**

The high-level management structure of RSVP derives from the historical fact that the K0PI0 and MECO experiments were independently conceived, developed and submitted to BNL for scientific

approval in 1996, before there was any thought of combining them into a single Major Research Equipment – Facility Construction (MRE-FC) proposal to the National Science Foundation (NSF). The two experiments agreed to combine in the submission of a single MRE-FC proposal to NSF in 1998 but, since then, have proceeded independently in their management and technical evolution.

In 2004, NSF made the decision to create a single RSVP management team (RSVP Project Director and Deputy). The AGS machine upgrades that were needed to accomplish the experiments had been separately incorporated into the technical and management structures of the two, K0PI0 and MECO, and their technical evolution had evolved through informal consultation with Collider-Accelerator Department (C-AD) personnel, rather than as a defined mission of the Department. The new RSVP project team has integrated the two experiments under a single Project Office and moved the AGS upgrades out of the experiments, creating a separate AGS Project to clarify lines of management responsibility. This reorganization also aligned the RSVP management structure with the content of the Memorandum of Understanding, signed by NSF and DOE in July 2004, to govern NSF's use of DOE's AGS machine and experimental area for NSF's RSVP scientific mission. This historical evolution has resulted in a level of complexity in the RSVP management structure that is unusual in a project of this size and one that the LOG believes can be simplified to yield significant cost savings in the area of overall project management. The LOG offers a recommendation to this effect below and restates it as a general recommendation in the Executive Summary.

#### **Recommendation:**

1. *The LOG recommends that project management carefully examine the streamlining and consolidation of project offices; the goal is to apply valuable and scarce engineering resources to the short-term technical needs of the experiments.*

## **WBS 1.2 K0PI0 Project**

#### **Findings:**

The Overview of the K0PI0 Project was presented by Project Manager, Prof. Michael Marx of Stony Brook University. The K0PI0 collaboration is currently composed of approximately 100 collaborators from 19 institutions. The K0PI0 project is managed as a component of the RSVP Major Research Equipment – Facilities Construction (MRE-FC) Project for the National Science Foundation. The projects included in the RSVP MRE-FC are the RSVP Project Office, K0PI0 Experiment, MECO Experiment and the AGS Project. K0PI0 created a Draft Project Management Plan in April 2003 wherein the total project cost was estimated at \$56.4M (FY03) including contingency but not the \$13M (FY03) AGS portions now contained in the AGS Project.

At the time of the January 2005 LOG review, the K0PI0 cost estimate presented by the K0PI0 subsystem presenters at this review was \$106.2M (FY05) including 26% contingency. The K0PI0 project manager's estimated cost was \$116.6M (FY05) including 39% contingency. The project has experienced a cost growth of nearly a factor of two since the 2003 estimate. Dr. Marx indicated that a cost scrubbing exercise had been initiated and he presented the outline of a significant (~63%) possible de-scoping scenario that would be pursued by K0PI0. Marx presented a possible scope-reduction cost estimate, largely based on geometrical scaling from a 3.2M to 2.5M barrel inner diameter, but with other postulated savings, that reached a strongly reduced projected cost level of



\$75M (FY05\$) including 40% contingency. This geometrical size reduction was stated to preserve 80% of the acceptance for signal events relative to the full-scope detector. Marx also noted that the acceptance-reduced nominal event yield could be compensated by extended running time, or better signal-event recognition, or both. Recent simulation work in K0PI0, using a new maximum likelihood algorithm, indicates significantly improved event recovery over previous analysis algorithms. All this new information needs to be confirmed by further analysis and simulation studies.

K0PI0 is organized into 9 technical subsystems plus integration and project management. The preferred K0PI0 schedule foresees a 5-year construction period with:

- Engineering design start 2005
- Beam test 2008
- Detector test 2009
- Engineering Run 2010
- 1<sup>st</sup> Physics Run 2011

K0PI0 identified 4 tasks that they considered to be the most technically challenging and deserving of attention as soon as resources became available. These were:

- Vacuum tank needs
- Detector integration
- Design of low/high vacuum membrane and charged particle veto system
- Tungsten lined collimator

The Level-2 WBS cost elements of the K0PI0 Project were individually presented to the LOG and we report and comment on these presentations below.

### 1.2.1 Vacuum System

Findings:

The presentation of WBS 1.2.1 Vacuum System was made by Mr. Ralph Brown of BNL. The full-scope Vacuum System estimated cost is \$10.75M (FY05\$) including 69% contingency. The Vacuum subsystem consists of a large volume vacuum vessel with challenging specifications including the upstream vacuum vessel and entering/exiting beam pipes, vacuum transitions, D4 vacuum box, downstream vacuum vessel, vacuum pumping stations and management activities. The K0PI0 plan is to design and build the components of the Vacuum system in Russia.

Comments:

The 69% contingency is *not* too high considering the challenging nature of this component. Special attention to safety will be required for this component, so coordination with the appropriate C-AD and BNL Safety committees should be started immediately. It will require a great deal of oversight for Q/A. The oversight and management budget appear too low. Preliminary engineering on this should be started soon.

### 1.2.2 Preradiator

Findings:

The presentation of WBS 1.2.2 Preradiator subsystem was made via a telephone conference by Dr. Toshio Numao of TRIUMF. The preradiator is the heart of the K0PI0 detector and the single largest

and most complex system, dominating the total number of electronics channels and accounting for approximately 30% of the total current estimated K0PI0 cost.

The preradiator must provide gamma-ray measurement (position, direction, and energy), provides an external photon veto, and acts as the trigger for the experiment. The design calls for 32 modules arranged in four quadrants around the kaon decay region; each quadrant has an active area of approximately 2m x 2m. The modules are composed of nine layers of scintillator, with embedded fiber readout, sandwiching eight chambers. Both the anodes and the cathodes of the chambers are read out to provide timing and pulse-height measurement respectively. The full preradiator is two radiation lengths thick in a total spatial dimension of approximately 1 m.

The present status of the preradiator R&D is well advanced. Scintillator "planks" have been fabricated with holes for fiber threading, and the plank machining to permit the tongue-and-groove assembly of the scintillator planes is perfected. A gluing jig is being manufactured. The energy resolution due to photon statistics alone is  $2.7\% / E^{1/2}$  [E in GeV], and the light yield uniformity across the planks gives a 1.5% contribution.

Several prototype chambers have been constructed (although none of them is full-size) and have demonstrated the spatial resolution required (200  $\mu$ m). A full-size prototype will be constructed this year (2005).

The preradiator electronics provides for 98,304 anode readout channels, 98,304 cathode readout channels, and approximately 3000 photomultiplier readout channels approximately evenly split between the scintillator fibers and the 45 Shashlyk photon veto counter modules. The electronics cost (\$10.0M, plus an additional \$491k included in the photon veto WBS entries) is the largest component of the preradiator cost. Preamplifiers are being tested with the prototype chambers, and cables, HV boards, and anode and cathode readout board prototypes have been developed. Current cost estimates are \$38/channel for the anode readout, and \$32/channel for the cathode readout.

There is currently no group identified as supplying the external veto counter. This system will use a Shashlyk design with identical modules as used in the calorimeter, and is costed at \$3.0M.

The cost estimates for the preradiator are based on commercial products (35% cost-weighted) and conceptual designs (65%). The total cost estimate is \$30.85M (FY05\$), including a contingency of 17%. The K0PI0 project manager, in his overview talk, indicated that significant cost savings might be realized during scrubbing, but also presented an estimate for overall K0PI0 costs which was 23% higher than the "standard" cost, based on an increased contingency allocation. In the case of the preradiator he increased the contingency from 17% to 44%.

#### Comments:

The design work on the preradiator appears well advanced. In view of the importance of this subsystem, the LOG encourages the collaboration to proceed with prototyping while exploring substantial cost reductions including possible descoping, as advocated elsewhere in this report.

### 1.2.3 Calorimeter

#### Findings:

The presentation of WBS 1.2.3 Calorimeter subsystem was made by Dr. Vladimir Issakov of Yale University. The K0PI0 Calorimeter subsystem cost estimate is \$9.73M (FY05\$) including 24% contingency. The calorimeter will be built with a new advanced Shashlyk-technique that allows resolutions of  $3\%/E^{1/2}$  and sub-100 ps timing. The calorimeter module construction is similar to standard Shashlyk calorimeter technologies used in other experiments, but with much finer-sampling Calorimeter modules to be built in Russia. The instrumentation utilizes Yale-designed electronics. A detailed cost estimate exists for this subsystem.

Comments:

The 24% contingency seems low for a project whose cost estimate has risen 70% in 3 years. There is a detailed cost estimate, but that may not justify this low a level of contingency. From a technical perspective, the calorimeter can be built, but it may cost more and could end up with less timing and energy resolution performance. It is not clear how critical these timing and energy resolution specifications are to K0PI0 and whether there was any performance margin should the calorimeter fall short of specifications.

#### 1.2.4 Charged Particle Veto

Findings:

The presentation of WBS 1.2.4 Charged Particle Veto subsystem was made via a telephone conference by Dr. Andries van der Schaaf of the University of Zurich. The Charged Particle Veto (CPV) system has estimated costs of \$5.70M (FY05\$) including 38% contingency. The CPV system has 3 components: a barrel CPV composed of scintillator modules with PMT readout, a beam chamber that consists of a 5-plane low pressure multi-wire proportional chamber (MWPC), and a downstream CPV, also made of scintillators with PMT readout. The three components are located inside the vacuum decay tank and downstream vacuum beam pipe.

Comments:

The goal for inefficiency rates appear to be difficult to achieve in an actual experiment, although it was stated that E949 was able to obtain similar levels of inefficiencies. Wire chambers can be difficult to operate in a vacuum. A lot of R&D is needed for the MWPCs. The scintillator technology is straightforward.

#### 1.2.5 Photon Veto

Findings:

The presentation of WBS 1.2.5 Photon Veto subsystem was made by Dr. Oleg Mineev of the Virginia Polytechnic Institute and State University. The Photon Veto has estimated costs of \$11.72M (FY05\$) including 35% contingency. The detector consists of an Upstream Photon Veto, Barrel Photon Veto, Magnet Photon Veto and a Downstream Photon Veto. All detectors consist of lead-scintillator sandwich modules with wavelength shifter fiber and photomultiplier readout.

Comments:

The mechanical engineering for this subsystem, especially the Barrel Photon Veto will be challenging. Hermeticity is important and based on the schematics shown at the review, the barrel support appears to be quite difficult. Obtaining the  $2 \times 10^{-4}$  detector inefficiencies will also pose a significant challenge. Considering the number of mechanical engineering problems that need to be addressed, a 21% contingency is too low. The fringe-field levels on the various PMTs of the Photon Veto system should be studied, especially those of the Magnet Photon Veto wall. At this

point in time it is not clear that the barrel photon veto detector can be built without a significant amount of internal mechanical support, which may compromise the sensitivity if the experiment.

#### 1.2.6 Catcher System

##### Findings:

The presentation of WBS 1.2.6 Calorimeter subsystem was made by Dr. T. Nomura of Kyoto University. The Catcher system was cost estimated by the KOP10 project manager at \$3.05M (FY05\$) including a 0% contingency and will be fully funded by Japan. The Catcher system consists of Pb-Aerogel and Pb-Acrylic Cerenkov modules optimized to detect photons from  $K_L$  decays in the beam pipe while remaining insensitive to the large neutron flux.

##### Comments:

There is no contingency in this element, but this is a system provided by Japan, where the commitment is to provide a complete, working Catcher system. It is expected that there will be a formal agreement between the Japanese funding agencies and NSF for the Japanese obligation in the event of a cost increase during the production phase of the Catcher system.

#### 1.2.7 Trigger

##### Findings:

The trigger subsystem was presented by Aniello Nappi of the University of Perugia. The system requirements are to collect  $\pi^0 \nu \bar{\nu}$  events with 95% efficiency, while operating at rates up to 1MHz (optimization to date was based on a 100kHz rate). The conceptual design calls for a deadline-less, two-level, digital, pipelined system.

The system includes trigger digitizers, collector boards and logic modules, a trigger supervisor, and a clock module. The Level 3 trigger, based on full event reconstruction with a PC farm, is not included here but is a part of the DAQ subsystem (1.2.8).

The current design calls for several custom modules, probably based on high-performance FPGAs, to be developed. The clock module will likely be adapted from the PHENIX design.

The system is cost estimated at \$5.93M (FY05\$), including 41% contingency. The Project Manager's estimate increased this contingency to 59% and the total estimated cost to \$6.7M.

The Trigger system manager estimates 25 person-years of electrical engineers and 25 person-years of physicists are needed to complete the project. While the start of construction funding may allow engineering manpower to be hired, the lack of physicist effort is critical; no collaborating groups are providing significant levels of involvement in the system design and development at this time.

##### Comments:

A major issue with this subsystem is a lack of manpower. The estimates of required manpower presented to the committee, including physicists, engineers, and technicians, appear reasonable, but the source of the manpower is not yet known. For example, the architecture definition phase requires both physicists (2 FTE) and engineers (1/2 FTE); for it to occur by mid-2005 this manpower must be in place soon. In view of the conceptual nature of the design at this stage, the level of contingency presented (41%) is probably low. The system, as presented, involves the development of several custom electronics boards. A solution that tries to maximize the use of

existing and proven electronics systems should be sought. This subproject will need a significant number of people to bring to a successful completion. They need to be identified soon. K0PI0 should consider adapting an existing trigger system from another experiment.

### 1.2.8 DAQ

#### Findings:

The WBS 1.2.8 DAQ and Level 3 trigger subsystem was presented by Dr. George Redlinger of BNL. The DAQ system is responsible for transfer of the digitized data from the front-end electronics, combination of the event fragments into full events in the event builder, application of Level 3 trigger criteria, and storage of the selected events onto a permanent medium.

The DAQ/L3 performance goal anticipates a 1 MHz input Level-1 trigger rate and plans to output recorded Level-3 event candidates at a few kHz. With the current detector configuration this would result in a data rate into the event builders of approximately 30 GB/s.

In the current plan, largely conceptual, the front end electronics would be read-out through approximately 50, 10 Gb/sec links into a commercial switch which will route the data (event fragments) to one of 100 event builders running in parallel. After event re-construction, each event would be routed through a 1 Gb/sec link to a Level 3 processor. The full L3 system would comprise approximately 400 nodes. The online control software will be adapted from the CMS XDAQ project.

Although much of the hardware would be commercial, there is a possibility that the L3 system would have a custom component (hardware co-processors). The WBS estimated costs include \$2.1M for this component, which as yet has no specifications and no design; this number is 31% larger than the budgeted cost of the Level 3 trigger farm.

The current status is that a small test cluster of 12 processors and an 8-port switch has been set up to test real-time performance. More detailed estimates of the expected data rates are required, as well as the development of trigger algorithms and a complete, coherent, design of the DAQ/L3. The CMS XDAQ online software must be studied and possibly modified for K0PI0 use.

The system is cost estimated at \$5.72M (FY05\$), including 25% contingency; the Project Manager's estimate increased the contingency to 36%, giving a system estimated cost of \$6.2M. The cost profile wisely puts most of the purchasing in the FY 2008 and FY 2009, in view of the evolution, under Moore's Law, of computing and networking hardware to lower prices for computing equipment over time.

#### Comments:

The major issues with this subsystem are manpower and incomplete information about event size and rates. Physicist and software engineer manpower is needed to develop trigger algorithms and overall system design; more precise information about event rates and event sizes will help to better define the required system performance, and hence the cost. Again, physicist manpower appears to be the more difficult problem if it is assumed that engineering and technical manpower can be hired using construction funds. Although much of the hardware will be commercial, the committee feels the larger contingency figure presented by the Project Manager is realistic in view of the current knowledge of the system requirements. In view of the uncertainty in the required and achievable

performance of the Level 3 system, the committee views development work on the custom component (hardware co-processors) as a low priority.

### 1.2.9 Offline Computing

#### Findings:

The offline computing subsystem was presented via a telephone conference by Dr. Renee Poutissou of TRIUMF. She presented a conventional offline processor farm of 200 nodes, purchased on a progressive time plan that delays the last 50% until near the project end. The system hardware includes the compute farm and individual workstations (15) required by visitors. The software includes the simulation, reconstruction, and analysis tools. This is a relatively small computing plant in terms of typical collider physics experiments. The current estimated cost is \$2.92M (FY05\$), including 9% contingency. Project Manager Marx raised this to \$3.23M, including a contingency of 20%. All of the hardware will be commercial, and estimates have been based on current CPU farms and reasonable extrapolations of computer performance until 2009, when most of the purchases will be made. The manpower budget before contingency is \$1.6M, primarily for computer professionals; the total manpower estimate is dominated by (uncosted) physicist effort. The status is that most of the work going ahead at the present time is on simulations. As the number of collaborators working in this area grows and the demands of simulation decrease, work will shift to event reconstruction and physics analysis. The software used by the GLAST collaboration is being investigated as a starting point for the KOPIO offline effort. Dr. Poutissou noted the shortage of staffing levels at the present time and the need for representatives from each subsystem to help define the overall software environment and structure.

#### Comments:

This subsystem is in the typical position for a startup experiment effort. The computing plant is of a conventional type and should present no serious difficulties in formulation and realization. The simulation effort will be challenged to foresee the potential backgrounds in this very rare signal environment. The plan to defer acquisition of the majority of the hardware until just prior to running is a reasonable one in view of the evolution of computing performance. However, the LOG questions how well the required computing power is known and believes that this uncertainty should be reflected in a larger contingency. The L3 online processing farm should be investigated for offline processing as well, given the probable small duty cycle of KOPIO running at the AGS. Physicist manpower is a critical issue because the groundwork for the hardware purchases must be in place substantially before FY09. The fact that KOPIO is now a funded project at NSF should help in the recruitment of new collaborators to help in the software efforts.

### 1.2.10 Detector Systems

#### Findings:

The presentation of WBS 1.2.10 Detector Systems was made by Mr. Ralph Brown of BNL. The Project Detector systems subproject covers KOPIO subsystem integration and installation. The subproject cost is \$11.69M (FY05\$) including 32% contingency. The resource-loaded schedule for KOPIO was stated to come from an engineering estimate based on direct experience with similar large detector construction projects (STAR/RHIC). The description of this subsystem element was quite sketchy and appeared to be more a scheme for accomplishing the work than a developed plan with properly articulated scope. The issues noted to be of concern in the presentation were funding to support engineering effort, utility requirements of the detector subsystems, plans for assembly and installation from the KOPIO subsystems and integration interfaces.

Comments:

This is a large cost item and needs to be more firmly addressed in the near future in order to properly assess its contribution to the overall K0PI0 cost estimate. The presented cost estimate appeared to be reasonable, perhaps high, based on similar experiments, however, no justification was shown for the presented estimate. Currently, only one engineer is working on this, part-time. The project could use a fulltime designer/engineer after the project is base-lined.

### 1.2.11 Project Services

Findings:

The presentation of WBS 1.2.11 Project Services was made by Mr. Steve Kane of BNL. As presented, the K0PI0 Project Office is intended to be a level-of-effort WBS subsystem that supports administrative roles (Project Manager, Deputy, budget/schedule person, administrative assistant) and technical roles (chief engineer, front-end electronics coordinator, liaison for AGS work). The Safety, QA, document control plus budget and scheduling functions will be performed by the RSVP Project Office. The staffing of this office is for five project years with a sixth year added as contingency. The cost estimate for this subsystem element, as presented, was \$8.1M (FY05\$), including 11% contingency. The K0PI0 project manager's estimate raised this to \$8.39M (FY05\$), including 15% contingency. Kane reported that all the technical staff for the project office were on-board and involved. Kane also stated that overhead charges at BNL are unclear because of the fact that this is a NSF project at a DOE laboratory. He was concerned about a project delay causing marching army costs.

Comments:

As in other areas of the RSVP Project, the committee felt that the historical evolution of the RSVP Project has given rise to an overly dispersed project management operation. Is a front-end electronics coordinator necessary in view of the fact that the vast majority of channels are provided by a single sub-system? Also, overhead rates at BNL should be clarified quickly. The K0PI0 Project Services operation, together with the overall RSVP Project Office, should be looked at carefully to avoid overlap and duplication. We address this observation in a general recommendation of this report.

### **General Comments on K0PI0:**

A number of the technical issues identified by K0PI0 as the most pressing: Vacuum tank design; detector integration; the high/low vacuum membrane; and the collimator. All these project elements are challenging and should be addressed by identifying and allocating the appropriate engineering and designer resources once funding becomes available. The Vacuum system seems especially challenging and will require significant oversight during both the design and fabrication stage of that subproject. Engineering design of the Vacuum subsystems should start as soon as possible.

All detector subsystems have conceptual designs with performance specifications that appear realistic. It should be possible to build each subsystem and operate it at or close to the performance specifications presented at the review. However, the subsystem designs are all conceptual and almost all of the engineering, prototyping and technical work necessary to complete these sub-detectors have yet to be done. There can be little confidence in the subsystems' schedules or costs until significant progress can be made on the engineering designs of the subsystems.

KOPI0 management indicated that a scrubbing exercise has started to reduce the project cost. In addition a de-scoping plan was outlined that would bring the project cost back toward the 2003 cost of \$56.4M (FY03). It is likely that the project cost can be significantly reduced from the current KOPI0 project manager's cost estimate of \$116.6M (FY05\$). However, a reasonable amount of engineering and design resources must be dedicated to the project before a reliable baseline project cost can be established. The project cost and schedule will be known much better, however, once both a Technical Design Report and fully loaded WBS project plan exist. The committee strongly recommends that this action be started in the near future, once the project has completed a scrubbing/de-scoping exercise that was described by the KOPI0 project manager during his presentation. The committee believes that the scrubbing/de-scoping action is essential if KOPI0 is to continue as a project. Very large uncertainties in the baseline cost of the experiment will exist until these two tasks are completed.

The size of the KOPI0 collaboration is at least a factor a two below what is needed to successfully complete the project.

#### **Recommendations on KOPI0:**

1. *In view of the challenges and scope of the project, the KOPI0 collaboration should actively work to attract more collaborators.*
2. *KOPI0 management should immediately act on the cost estimate scrubbing/de-scoping plan they outlined to the LOG.*
3. *Once the experiment has been re-scoped and scrubbed, KOPI0 should work toward creating both a TDR and bottoms-up, resource-loaded, linked WBS structure within the next 12 to 18 months.*
4. *Sufficient engineering and design resources should be dedicated to the project to establish a reliable baseline cost estimate and create both a TDR and WBS project plan.*

### **WBS 1.3 MECO Project**

#### **Findings:**

The MECO Project Overview was presented by MECO Project Manager, Dr. Michael Hebert of the University of California, Irvine. The most significant problem related to the MECO project overall is the impending departure of the project director, Michael Hebert. While the exact time frame of Dr. Hebert's departure was not communicated, the LOG did not hear evidence of progress in finding a successor. In his Overview presentation, Hebert gave a very short outline of the scientific basis for MECO, its organizational structure, a brief statement of the cost estimate history of MECO and a brief tour through the elements of the MECO subsystems and the technology choices that had been made. He finished up with a Project Manager's cost estimate rollup that differed in a few places from the presentations of subsystem managers that followed. A key statement on the cost estimate was that no bottoms-up cost estimate review had been done for MECO since June 2001. He stated that the cost estimates are still actively being revised, including how they were captured in the WBS structure. This aspect generated some difficulty for the LOG as it sought to understand the details in some of the WBS elements. No resource-loaded schedule is yet available but the project tools have been implemented in Microsoft Project and the subsystem managers will be loading in their data to this system.. He also noted that a systematic algorithm has been



implemented to derived contingency estimates for the project items. This algorithm was prescribed by the RSVP Project Office. The rolled-up cost estimate for MECO, with all academic salaries taken out was stated to be \$85.83M (FY05\$) with an included contingency of 28%. The Level-2 WBS cost elements of the MECO Project were individually presented to the LOG and we report and comment on these presentations next.

### 1.3.1 Extinction

#### Findings:

The WBS 1.3.1 Extinction System was presented, using a speaker-phone connection, by Prof. William Molzon, Univ. of California, Irvine, who serves as an interim Level 2 System manager. Molzon outlined briefly the scope of the work and presented the cost estimates at Level 2, including the cost estimate base and technical performance reliability. As presented the system includes:

- A way of measuring the time structure in the circulating AGS beam
- A magnet system in the primary proton beam that provides a time modulated magnetic kick phased with the proton micro-pulses
- A system of magnets, collimators and detectors that can be used to measure the time structure of particles in the extracted beam (upstream of the secondary extinction device) with a dynamic range of  $10^9$  within a few minutes
- A system of magnets, collimators and detectors that can be used to measure the time resolution of particles hitting the production target with a dynamic range of  $10^9$  within a few minutes

The technical level of confidence is identified as “similar system exists” and “similar technology works”. The system base cost is 2.28M\$ (FY05\$) which includes 1.03M\$ for M&S, 0.36M\$ for Labor and 0.69M\$ for Contingency. Since only 20% of the system cost is identified as a commercial product and 5% as engineered design whereas 35% is based on a scientific concept and 35% is just a guess, the contingency was assigned on the level of 43% of total system cost. From the presentation and following discussions, the LOG understood that this system suffers from a lack of engineering support. To advance the work, more physicist, mechanical and electrical engineer efforts are required. However, funds for such work, in most of the cases (except a mechanical engineer for which the MECO Project has funding for one year), are not available at the present time. Testing the performance of both the extinction in the AGS and the performance of this device in a beam are both critical, and the currently foreseen schedule is very late.

#### Comments:

The LOG recognizes that the extinction system is one of the key technical systems needed to provide required beam parameters for the MECO experiment. The LOG observes that the scope of the work and boundaries with similar works within the AGS project are not well defined.

### 1.3.2 Production Target & Shield

#### Findings:

The WBS 1.3.2 Production Target and Shield was presented by Acting Level-2 System Manager, Dr. Michael Hebert of the University of California, Irvine. The cost of the MECO production target and shield is \$2.76M (FY05\$) including 41% contingency. The MECO production target is made of tungsten surrounded by a water-cooling system encased in a titanium jacket. The water-cooled heat shield is expected to limit nuclear heating and radiation damage to the target assembly. CA-D had looked at some aspects of the design, especially cooling and assembly. However, the engineer at BNL who was leading the effort at BNL left and the collaboration is seeking a new collaborating institution that can take on the engineering and fabrication. Dubna was named as a possibility. The design studies are primarily the responsibility of UC-Irvine.

Comments:

Some of the LOG members felt that the 41% contingency might still be too low, given the uncertainties in the project. Given the expertise at C-AD and the necessity for close collaboration with them, it might be desirable to shift most of the design and engineering of the production target and shielding to the AGS part of the project.

### 1.3.3 Solenoids

Findings:

The scope of work on the MECO superconducting solenoid system, WBS 1.3.3, and the system cost estimate was presented, using a speaker-phone connection, by Dr. Brad Smith, MIT Plasma Science and Fusion Center. Dr. Smith serves as the Level-2 System manager. The system consists of three superconducting solenoids (production solenoid PS, transport solenoid TS and detector solenoid DS) including their thermal shields, vacuum vessels, internal sensors and interface connections; the magnet power supplies; the control system; the liquid helium refrigerator/liquefier; and the control box for cooling distribution. The conceptual design of this system is in a mature stage. It was developed by the MIT superconducting magnet group in 2001-2002 and described in a Conceptual Design Report (CDR) and its updates. The technical level of confidence of this system is identified as "similar technology works". The design represents the assembly and integration of a large number of components, most of which are considered to be technologically similar to previously developed and fabricated items. The technical aspects of this system were periodically reviewed by the MECO Magnet Oversight Committee; this committee includes national and international magnet experts.

The total cost of the system is \$55.20M (FY05\$) including \$18.6M of M&S and \$12.4M of Labor. The system contingency was set at a quite low level of \$12.3 M, or 29% of the total system cost, due to the mature stage of system development. The M&S cost estimate is based on a bottoms-up estimate of the individual cost elements. The Labor cost is estimated based on a detailed hourly breakdown of each task, using appropriate labor categories with industry-standard labor rates. The cost of key components such as superconductor, coil mandrels, magnet yoke iron, power supplies, quench protection equipment, refrigerator/liquefier, as well as the costs for each of the PS, TS and DS magnet cryostats and their components, which comprise 56% of the estimated WBS 1.3.3 total cost, were based on "vendor quotations". The solenoid costs have been reviewed twice, the first time in February 2002 after finishing the CDR and the second time in October 2004 during the RSVP magnet review, and were relatively stable. The LOG was convinced that the presented WBS 1.3.3 cost and contingency levels are reasonable and well justified.

The magnet design activities of high priority have been identified and discussed by the MECO team during the October 2004 review and the funding request to support them in FY2005 has been submitted by RSVP. The total amount of supplemental funding for the magnet work is \$690K. It is assumed that these funds, if awarded, will reduce the total system cost from \$55.2M. The magnet fabrication issues were discussed with potential vendors during the last international conference on magnet technologies. Several large, medium and small companies expressed interest in participating in the fabrication of these magnets *or their components*. This outcome allows the possibility of considering several different procurement scenarios, one or more of which may lead to significant potential cost savings.

Comments:

The LOG recognizes that the MECO solenoid system is the most expensive and probably the most time consuming item of the MECO hardware. The presented cost estimate and contingency are reasonable and well justified. The LOG endorses a study of different magnet procurement strategies in order to minimize the magnet fabrication cost and time, as well as the technical risks. This procurement study will provide the base for a final design and fabrication plan that will lead to one or more Request for Proposals (RFPs) for the magnet system. The LOG agrees that the schedule for this plan is highly dependent upon the timely arrival of funds from both the Supplemental Request and from the FY 2005 RSVP MRE-FC funding authorization.

The LOG strongly supports the idea of a task sharing arrangement, proposed by MIT, that would promote involvement by BNL personnel in the development of the final magnet designs and peripheral equipment. The magnet final design phase must deliver the documentation package for a magnet RFP. This package will include a scope of work for magnet production and fabrication, plus specifications that define key requirements for both magnet performance and safety constraints. A clear procedure for implementing BNL safety committee requirements into the magnet design work and into the magnet documentation package is vitally important. Certainly the prompt clarification of BNL's role in these activities will simplify and accelerate this work.

#### 1.3.4 Muon Beamline

##### Findings:

The WBS 1.3.4 Muon Beamline was presented by Dr. William Morse of BNL. The muon beamline consists of all the elements, except the superconducting magnets, that convey negative muons from the primary beam target in the production solenoid, through the transport magnet, to the detector solenoid beam dump. The system consists of nine major elements that select muons of the correct charge and momentum, stop them in a series of thin foils and absorb the portion of the beam that is not stopped in the target. These include the vacuum system, collimators, the stopping target and monitor, absorbers, shielding, the muon beam stop and detector support structures. The cost of the muon beamline is \$3.59M (FY05\$) including a contingency of 26%. This represents approximately a 50% cost increase for this subsystem. At this point in time, there exists only a partially completed conceptual design of the complicated region at the downstream end of the Detector Solenoid.

##### Comments:

Much of the design of the Muon Beamline is still conceptual. In order to complete the design, engineering support, most likely from C-AD, is required as well as input from muon beam transport simulations. While similar systems exist in the case of the beamline, the interface with the experiment is unique and is not yet well specified. In light of this, the 26% contingency appears to be low.

#### 1.3.5 Tracker

##### Findings:

The WBS 1.3.5 Straw Tracker was presented by Prof. Edward Hungerford of the University of Houston. The MECO tracking subsystem cost is \$5.59M (FY05\$) including a 19% contingency. Project manager Hebert listed this cost as \$3.78M, also including a contingency of 19%, the lower cost version of the design. There are two different designs under consideration. The first, and most mature, is the Longitudinal, or L-Tracker. This detector uses a combination of outer resistive and inner conducting straws and cathode strips which are divided into pads. The straws are distributed in vanes and the straws are arranged parallel to the Detector Solenoid axis. Recently, MECO has also designed a Transverse, or T-Tracker, in which conducting straws are arranged perpendicular to the Solenoid axis. The stated advantages of the L-tracker are: 1) better background rejection than

the transverse tracker, presumably because of the cathode readout; 2) A tested prototype has been built, although it is shorter than the 3m of the full-scale tracker. The advantage of the T-tracker is that it is expected to be easier to build because of the shorter straws (1m) and a smaller channel count (13k as compared to 20k for the L-tracker). It was stated that, in simulation, both technology choices “appear to meet the physics requirements”. The plan is to continue with development of both detector types and to make a choice at some time in the future. The decision would be based on performance of prototypes and on studies of reconstruction software.

Comments:

For an experiment so low on resources, carrying two technology choices for a long time is a drain. Given the assertion that both detectors are expected to “meet the physics requirements” of MECO and that both tracker types are technologically reasonable, the LOG suggests that a decision be made on a tighter, more definite timetable than is suggested in the tracker presentation. If there are rate or timing problems that were not discussed in the presentation, but which might affect the outcome, then this should be determined as soon as possible. Carrying two technologies on an experiment this low on resources, while asserting that at least one will work satisfactorily, is not the best use of resources. The 19% contingency is too low, given the uncertainties in the project. However, we were told that the actual contingency should have been reported as 37%, a more reasonable level.

### 1.3.6 Electron Calorimeter

Findings:

The WBS 1.3.4 Electron Calorimeter was presented by Prof. Peter Nemethy of New York University. The calorimeter consists of 1152 lead tungstate crystals. Each crystal is equipped with 2 large-area Avalanche Photo-Diodes (APDs). The crystal-APD package is cooled to  $-24$  deg C to increase the light output of the crystals and reduce the dark current from the APDs. The calorimeter provides the trigger for the experiment. In order to control costs, the calorimeter was redesigned with fewer crystals and coarser segmentation. The total cost of the calorimeter is \$6.30M (FY05\$). This includes a contingency of 26%.

Comments:

The LOG believes that the 26% contingency on the equipment cost of the calorimeter may be too small. In particular, the contingency on calibration and monitoring, the mechanical housing and cooling seem low given that these systems are not completely designed. Crystal procurement is almost always a schedule issue for both large and small projects. Even though this procurement is for a relatively small number of crystals, care should be taken to assign adequate schedule contingency.

### 1.3.7 Cosmic Ray Shield

Findings:

The WBS 1.3.7 Cosmic Ray shield was presented by Dr. Yuri Kolomensky of the University of California, Berkeley. The cosmic ray shield covers most of the solid angle of the MECO Detector, including the entrance portion of the spectrometer and the area under the detector. It consists of a triple layer of extruded scintillator bars with wavelength-shifting fiber readout into Hamamatsu multi-anode PMTs. This is modeled after the successful MINOS approach. It is not possible for the shield to be completely hermetic due to holes required for the muon beamline, supports and services. Hermeticity is less important than achieving an overall inefficiency of  $10^{-4}$ . The total cost of the cosmic ray shield is \$1.66M (FY05\$) including a contingency of 13%.

Comments:

No significant engineering has been done on the cosmic ray shield. The LOG believes that the applied contingency of 13% is significantly low. Rigging costs associated with the cosmic ray shield do not appear to be accounted for in the presented cost estimate.

### 1.3.8 DAQ & Online Computing

Findings:

The WBS 1.3.8 Trigger and DAQ was presented by Dr. Krishna Kumar of Boston University. The participating institutions are Boston University and the University of Massachusetts. The cost estimate for the MECO trigger and DAQ subsystem is \$2.60M (FY05\$) including 24% contingency (M. Hebert showed an estimate of \$2.47M including 18% contingency for this item). Kumar stated that the work characterization so far is mostly an engineering concept with existing technology and is just beginning. MECO expects to emulate the features of successful, existing Trigger/DAQ systems. The anticipated MECO trigger and event rates need to be refined. The trigger algorithms and reconstruction software cannot be started until funding is made available. The trigger rate is expected to be between 1-2 kHz and the data rate into the event builder is 1 Gb/s.

Comments:

This MECO subsystem is at a very early stage of characterization, but is of a fairly standard type and does not present particularly difficult design challenges. The main goal in this subsystem needs to be organization and refinement of the needed work and definition of the required staffing levels.

### 1.3.9 Simulation & Offline Analysis

Findings:

The WBS 1.3.9 Simulation and Offline Analysis was presented by Dr. Yuri Kolomensky of the University of California, Berkeley. The lead institution is UC Berkeley. The cost estimate for the MECO Simulation and Offline Analysis subsystem is \$0.93M (FY05\$) including 45% contingency. The elements of this subsystem include MECO simulation and offline analysis for all the aspects of the experiment. Essentially all of the programming effort was stated to be provided by participating physicists and not part of the MECO project budget. The cost estimated items are computing equipment from commercial sources. This work is just getting underway and the needed physicist staffing is only about 2/3 present in the Collaboration. Recruiting these collaboration members is seen to be a challenge.

Comments:

As in many subsystems in the RSVP experiments, the recruitment of additional Collaboration members should become easier as the MECO experiment begins to look more real with the approval of MRE-FC funding from NSF starting in FY 2005. The challenges of the MECO simulation and offline analysis are, in general, not of particular difficulty since the detector is fairly simple and the physics processes largely understood. What will be difficult, will be anticipation of the more esoteric backgrounds, mostly generated by cosmic rays. This will be the challenge to the simulation studies and to the offline analysis.

### 1.3.10 Installation & Integration

Findings:

The task was presented by Dr. Michael Hebert, Univ. of California, Irvine, the present Level 1 MECO Project manager, who also serves as WBS 1.3.10 interim Level 2 task manager. This task is

intended to contain the installation efforts for all MECO subsystems, including any specialized rigging fixtures that may be required, in an effort to coordinate them into a single MECO installation plan. The installation and integration costs were originally embedded in the individual subsystems. Most have not yet been moved into the Installation and Integration subsystem. This task also includes integration of common systems across the whole of the MECO project and establishes the requirements for associated AGS conventional systems (power, chilled water, etc.). Integration includes the mechanical interface control tasks coordinated by the MECO Chief Mechanical Engineer and, similarly, the electrical interface tasks of the MECO Chief Electrical Engineer, plus associated Designer effort in preparing envelope drawings, etc. The technical level of confidence of this system is identified as “similar technology works”. The total cost of the work is \$3.20M (FY05\$) including \$0.11M for M&S, \$1.57M for Labor and \$0.65M for Contingency. The assigned level of contingency is only 28%, although the cost estimate is based 50% on engineered concepts and the other 50% on scientist concepts. Project manager Hebert lowered this estimate in his rollup to \$3.07M including 26% contingency. It was admitted that no designs for any specialized installation hardware are available at the present time. No modeling of installation sequencing was performed and only minimal studies of services-routing and subsystem envelopes have been completed. The LOG understood that this circumstance is partially due to the lack of resources (funding, stuff, etc.) to perform this work. The project has not found suitable candidates for the MECO Chief Mechanical and Electrical Engineers. As a result, the preparation of both the WBS 1.3.10 plans and their associated costs had suffered.

**Comments:**

The LOG believes that this part of the MECO Project has not yet reached an adequate level of maturity, both in terms of understanding of the scope of work, and its cost estimate. The LOG also believes that the level of coordination of this part of the MECO project with corresponding parts of the AGS Project is not sufficient. For example, the boundaries of the Extinction system with the development and integration of the Superconducting Magnets are not well defined or optimized. Certainly the improvement of coordination in those areas would improve the confidence level of the cost estimate and project contingency. The LOG supplies a recommendation below that addresses this area of work.

**1.3.11 MECO Project Office**

The WBS 1.3.11 MECO Project Office was presented by MECO Project Manager, Dr. Michael Hebert of the University of California, Irvine. Dr. Hebert made a very brief presentation in which he stated the staffing level planned for the project office, the Project Manager, a Schedule Manager and an Administrative Assistant, all full-time. Some travel and office equipment costs were noted. The estimated total cost for the project office for 5 years of operation was \$4.14M (FY05\$) including a 29% contingency for a possible sixth year of project operations.

**Comments:**

The MECO Project Office operation, together with the overall RSVP Project Office, should be looked at carefully to avoid overlap and duplication. We address this observation in a general recommendation of this report.

**General Comments on MECO:**

The MECO Project appeared to have two distinct pieces, the Solenoid Magnet System and all the rest of the detector systems. The magnet system has achieved a professional technical and conceptual design study and has been reviewed several times by expert review committees. It now

has a credible cost estimate and a good technical basis for the start of engineering design and procurement. The remaining MECO detector systems have been the subject of effective R&D activities but have not made progress in most cases to a reliable and engineer-developed cost estimate. This is for clearly understandable reasons but still presents the pressing need to accomplish this phase of progress in order to have a reliable overall cost estimate for the MECO Project. In addition to this general observation, the LOG also notes that the magnet integration and installation subsystem could benefit from closer integration with the Collider-Accelerator Department and provides a recommendation to this effect below. The committee also notes the announcement that the MECO Project Manager, Michael Hebert has announced his intention to leave the project and urges MECO management to work with the RSVP Project Office to swiftly identify a qualified successor for this vital position. We offer recommendations to the MECO Project on these issues below.

### **Recommendations:**

1. *MECO management should immediately act on a cost estimate scrubbing exercise to sharpen up the quality of the cost estimate for MECO elements other than the solenoid magnet system.*
2. *The LOG recommends that RSVP project management reexamine the division of project responsibility in the areas of MECO Installation and Integration, WBS 1.3.10 and AGS MECO Project Support and Integration, WBS 1.4.4.1, with the goal of re-optimizing the cost, schedule and technical effectiveness of this area of work.*
3. *A plan for the replacement of Dr. Hebert must be made immediately and followed aggressively.*

## **WBS 1.4 AGS Project**

### **Findings:**

The AGS Project Overview was presented by Dr. Phil Pile, Associate Chair of the Collider-Accelerator Department and AGS Project Manager for the RSVP Project. Pile outlined the scope of the AGS Project and presented the overall cost estimates at Level-2, including the status of cost estimate maturity and technical performance reliability, as well as noting the ongoing process of ‘cost-scrubbing’ that is underway to refine and (hopefully) lower costs in the AGS Project elements. In general, Pile noted that the cost estimates were based on C-AD experience rather than completed engineering designs for specific RSVP technical items, but these items largely consist of deliverables that have been routinely designed, built and operated by the AGS for 50 years; their cost and schedule aspects are well known and predictable by the C-AD. He also asserted that the accelerator performance requirements were well within the technical envelope that AGS and Booster can expect to achieve using the items and methods in the Level-3 WBS. The technical issues were left to be addressed by the experts presenting the lower level WBS elements. The Level-2 WBS cost elements of the AGS Project were individually presented to the LOG.

#### 1.4.1 Booster AGS Modifications

##### **Findings:**

The WBS 1.4.1 sub-project was presented by Dr. Kevin Brown, C-AD accelerator physicist and sub-project manager. This WBS element contains all the permanent changes to the AGS (and

Booster) accelerator complex that are required to upgrade and operate the accelerators for the RSVP experiments. WBS 1.4.1 has a current total construction cost estimate (FY05\$) of \$21.33M with an included contingency of \$3.8M (22%). This cost element has grown dramatically from the early RSVP cost estimates due to the imposition of requirements for radiation damage mitigation and environmental protection actions that were not addressed in the early cost estimates made in the K0PIO and MECO project management and design contexts, but that were clearly imposed when the NSF-DOE Memorandum of Understanding was completed and signed in July 2004. At the time of this review, the costs had been well estimated and had undergone a process of cost scrubbing that was stated to be 82% complete for the 1.4.1 cost element. The scrubbing will be completed before the May 2005 presentation to NSF. The lower-level costs were well developed for this WBS item. It should also be noted that there were no technical 'show stoppers' that would prevent the achievement of K0PIO and MECO technical requirements. These technical requirements were discussed in various ways during the AGS presentations and the least well documented performance characteristics (e.g., proton extinction between MECO bunches) will be the subject of machine development runs in later project years. Taking into account all the technical control elements planned for the machines, the LOG was confident that the AGS-Booster upgrades will meet the performance requirements of the RSVP experiments.

#### 1.4.2 Switchyard

##### Findings:

The WBS 1.4.2 sub-project was presented by Mr. Alexander Pendzick, C-AD senior engineer and sub-project manager. This WBS element contains all the permanent changes to the AGS Switchyard required to upgrade and operate the primary proton beams for the two RSVP experiments. WBS 1.4.2 has a current total construction cost estimate (FY05\$) of \$5.09M with an included contingency of \$0.9M (21%). This cost element has grown substantially from the early RSVP cost estimates due to the management decision to clear out the complicated switchyard elements that were earlier used to provide split primary beams for simultaneous operation of several slow-spill AGS experiments. K0PIO and MECO use completely different primary beam energies (24 GeV and 8 GeV, respectively) and need the full proton intensity accelerated in each AGS cycle. As a result, the two experiments will not be operated simultaneously, allowing a drastically simplified switchyard that dramatically lowers switchyard operating cost and equipment failure risk, and also strongly limits maintenance costs and personnel radiation exposures. The switchyard reconstruction was not considered in the early cost estimates made by K0PIO and MECO project management. At the time of this review, the costs had been well estimated and are undergoing a process of cost scrubbing that was stated to be 60% complete for the 1.4.2 cost element. The scrubbing will be completed before the May 2005 presentation to NSF. The lower-level costs were well developed for this WBS item. The technical requirements were simplified relative to earlier switchyard operations and the elements of the reconstructed switchyard have minimal technical and cost estimate risk. The LOG was confident that the Switchyard Upgrade will meet the performance requirements of the RSVP experiments.

#### 1.4.3 K0PIO

##### Findings:

The WBS 1.4.3 sub-project was presented by Mr. Charles Pearson, C-AD engineer and sub-project manager. This WBS element contains the K0PIO target station, neutral beam magnet and collimation elements plus the experimental area modifications needed by K0PIO. It also includes vacuum, controls, beamline instrumentation and safety systems for the primary and secondary beam areas. It includes a large new pit in the AGS floor that will allow the large K0PIO detector to be



positioned at standard AGS beam height. WBS 1.4.3 has a current total construction cost estimate (FY05\$) of \$11.63M with an included contingency of \$2.5M (27%). This cost element has grown substantially from earlier cost estimates assembled by K0PI0 project management when the AGS cost elements and deliverables were included in the RSVP experiments' technical scope. At the time of this review, the costs in WBS 1.4.3 had been well estimated and are undergoing a process of cost scrubbing that was stated to be 53% complete for the 1.4.3 cost element. The scrubbing will be completed before the May 2005 presentation to NSF. The lower-level costs were mostly well developed for this WBS item but were not drilled down by the LOG to the lowest cost estimate levels. The technical requirements of the K0PI0 beam and experimental pit were largely understood; however, there remain functionality questions about the neutral beam elements that are not fully validated and probably cannot be without actual neutral beam performance tests. Such tests are planned as part of the construction process. Examples include the specific ability of the neutral beam design to collimate the beam to the needed level of neutron/photon suppression and the ability of the neutral beamline elements to be aligned to realize the collimation apertures required. A higher level of contingency was applied to this WBS cost element to reflect these uncertainties.

#### 1.4.4 MECO

##### Findings:

The WBS 1.4.4 sub-project was presented by Mr. David Phillips, C-AD engineer and sub-project manager. This WBS element contains the MECO A-line primary beam components (except the RF Kicker), beamline shielding and experimental area modifications needed by MECO. It also includes vacuum, controls, beamline instrumentation and safety systems for the primary and secondary beam areas. It includes the preparation of the AGS floor for the installation of the large, superconducting MECO Magnets and the utilities infrastructure needed by the MECO Magnet and refrigerator system plus the experimental infrastructure beyond the magnet system. WBS 1.4.4 has a current total construction cost estimate (FY05\$) of \$11.97M with an included contingency of \$2.3M (23%). This cost element has grown substantially from earlier cost estimates assembled by MECO project management when the AGS cost elements and deliverables were included in the RSVP experiments' technical scope. At the time of this review, the costs in WBS 1.4.4 (as currently understood for the AGS Project role) had been relatively well estimated and are undergoing a process of cost scrubbing that was stated to be 36% complete for the 1.4.4 cost element. The scrubbing will be completed before the May 2005 presentation to NSF. The lower-level costs were relatively well developed for this WBS item but were not drilled down by the LOG to the lowest cost estimate levels. The remaining uncertainty of the MECO magnet and refrigerator procurement and installation strategy represents an overall uncertainty about the AGS Project scope of this WBS element, but the estimates made for this review are consistent with the assumptions made in the MECO WBS and no cost or scope gaps or double-counting were identified by the LOG.

#### 1.4.5 AGS Project Office

##### Findings:

The WBS 1.4.5 sub-project was presented by Dr. Phillip Pile, Associate Chair of the Collider-Accelerator Department and AGS Project Manager for the RSVP Project. This WBS element contains the effort for the C-AD construction management responsibilities in the RSVP Project. These responsibilities include the design, construction and installation of all the items in the scope of WBS 1.4, including safety, environmental assurance, quality assurance, tracking and reporting and all other normal project management functions for the C-AD mission in RSVP. The separation of this office from the K0PI0 and MECO Project Offices and their experimental detector WBS was

prescribed in the NSF-DOE Memorandum of Understanding of July 2004. The proposed staffing level includes the project head (Pile) and Deputy (Pendzick), each at a half-time level, plus another 0.85 FTE of matrixed support from C-AD for the electrical, mechanical, controls, Q/A, ESSH and procurement support as needed to carry out the AGS Project Management responsibilities. WBS 1.4.5 has a current total construction cost estimate (FY05\$) of \$2.80M with an included contingency of \$0.5M (20%). The contingency was stated to cover a possible 6<sup>th</sup> year of construction.

### Beam Development

#### Findings:

In addition to the MRE-FC Construction Project scope discussed in the WBS elements above, there are 'Beam Development' costs identified by the RSVP Project Office that would normally be included in the 'Pre-Operations' category, but that may be included in the MRE-FC Project by NSF. For the LOG Review, the beam development costs were stated by Phil Pile in his Overview talk but were not discussed in any detail in terms of cost estimate or technical scope and schedule implications. The total cost for 3 years of operations at 15 weeks per year was stated to be \$14.3M (FY05\$) with no contingency stated. There was no discussion of the cost basis for this estimate and no discussion of whether it would be included within the scope of the RSVP Project. Accordingly, the LOG is not able to comment on this cost category at this time.

### **General Comments on the AGS Project:**

The LOG found the AGS upgrade presentation technically knowledgeable and convincing and had no specific concerns about the ability of C-AD to carry out the required work in the five year project period. The cost estimates were credible and based on the 50-year experience at AGS of designing, constructing, installing and operating similar items for experiments run at the AGS. The LOG also noted that a cost-scrubbing exercise is ongoing in the AGS Project and will be complete by April-May 2005. Based on the scrubbing exercise so far (more than half done), the cost savings under the present project scope are likely to be small relative to the overall cost of this WBS item (\$52.8M). However, a significant portion of the presented costs for the AGS Project derive from radiation damage mitigation and environmental protection measures required under the 2004 NSF-DOE MOU; these requirements were not included in the earlier RSVP cost estimates. The LOG believes that there may be opportunities to reduce the estimated costs through vigorous cost scrubbing plus value engineering of the project scope in this sector. The LOG did not have time to pursue this issue to lower cost and scope levels in the present review venue. We offer a recommendation below in this area of work. The LOG also notes that the Beam Development costs of \$14.3M for 15 weeks of running in each of 3 years were stated but not otherwise presented. In consequence, the LOG cannot comment on this cost item.

The LOG was supportive of the K0PI0 plan to install and commission the neutral beam as early in the program as feasible in order to reduce the remaining technical performance risks. The LOG felt that the cost estimation of the K0PI0 sub-project area of the AGS Project was reliable for the items expected to be employed but recognizes that some of the neutral beamline elements may need to evolve as the beam is better understood. If the downsizing of the K0PI0 experiment is carried out, as recommended by the LOG elsewhere in this report, the size and costs of the K0PI0 pit can be expected to decrease. The contingency in this WBS element has been increased to compensate the remaining neutral beam technical risk. The LOG supports this approach to cover this risk, but it is not clear to the LOG whether the amount of incremental contingency is adequate for this purpose.

The LOG felt that the MECO plan for installation was not yet fully mature and it cannot be completed until the procurement plan for the magnet system and refrigerator are decided. However, for any procurement scenario, the installation of the MECO magnet system, with its power supplies, quench protection system and helium refrigerator, will require not only providing the appropriate space but also the appropriate utilities, as well as ensuring specific conditions for safe and reliable MECO equipment operation in the AGS environment. The LOG believes that some of these important aspects of the MECO Magnet System were not yet considered or clearly thought through in the current plan and cost estimates. The LOG urges AGS and MECO project management to analyze the impact of different procurement plans on the MECO installation-schedule and cost, as well as the level of participation of AGS staff in this work. The LOG also noticed that there is no clear distribution of responsibilities for the MECO extinction system development, test, procurement and installation (see comments above). The LOG believes that the procurement, installation and commissioning of the MECO Extinction system could be better technically supported as part of the AGS Project (WBS 1.4.4), a circumstance that would certainly lead to more efficient use of resources. We offer a recommendation below in this area of work.

### **Recommendations:**

1. *The LOG recommends that RSVP project management reexamine the division of project responsibility in the areas of MECO Installation and Integration, WBS 1.3.10 and AGS MECO Project Support and Integration, WBS 1.4.4.1, with the goal of re-optimizing the cost, schedule and technical effectiveness of this area of work.*
2. *The LOG recommends that RSVP management immediately undertake a systematic cost and scope review of the radiation damage mitigation and environmental protection elements of the AGS Project.*

## Appendix A



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**LOG Cost and  
Schedule Review**

[Data Sheets](#)

### Rare Symmetry Violating Processes Project

#### Laboratory Oversight Group (LOG)

#### RSVP Cost & Schedule Review

Brookhaven National Laboratory

January 18-20, 2005

#### AGENDA

<b>Tuesday, January 18, 2004</b>		
<b>Physics Building, 2-160</b>		
8:30 am	LOG Executive Session	
9:00 am	Project Director's Introduction	W. Willis
9:10 am	<a href="#">WBS 1.1 RSVP Project Office and Management Approach</a>	J. Kotcher
9:30 am	<a href="#">WBS 1.2 KOPIO Project Overview</a>	M. Marx
10:15 am	COFFEE BREAK	
10:30 am	<a href="#">WBS 1.2.1 Vacuum System</a>	R. Brown
10:50 am	<a href="#">WBS 1.2.10 Detector Systems</a>	R. Brown
11:10 am	<a href="#">WBS 1.2.2 Preradiator</a>	T. Numao

11:30 am	<a href="#">WBS 1.2.3 Calorimeter</a>	V. Issakov
12:00 pm	LOG WORKING LUNCH	
1:00 pm	<a href="#">WBS 1.2.7 Trigger</a>	N. Nappi
1:15 pm	<a href="#">WBS 1.2.4 Charged Particle Veto</a>	A. van der Schaaf
1:30 pm	<a href="#">WBS 1.2.5 Photon Veto</a>	J. Frank
1:45 pm	<a href="#">WBS 1.2.6 Catcher System</a>	TBD
2:00 pm	<a href="#">WBS 1.2.8 DAQ</a>	G. Redlinger
2:15 pm	<a href="#">WBS 1.2.9 Offline Computing</a>	R. Poutissou
2:30 pm	<a href="#">WBS 1.2.11 Project Services</a>	S. Kane
2:45 pm	COFFEE BREAK	
3:00 pm	<a href="#">WBS 1.3 MECO Project Overview</a>	M. Hebert
3:40 pm	<a href="#">WBS 1.3.1 Extinction</a>	W. Molzon
4:00 pm	<a href="#">WBS 1.3.2 Production Target &amp; Shield</a>	M. Hebert
4:15 pm	<a href="#">WBS 1.3.3 Solenoids</a>	B. Smith
4:45 pm	LOG Executive Session	
6:00 pm	RECEPTION AT BERKNER HALL	
7:00 pm	REVIEW DINNER AT BERKNER HALL	
<b>Wednesday, January 19, 2004</b>		
<b>Physics Building, 2-160</b>		
8:30 am	<a href="#">WBS 1.3.4 Muon Beamline</a>	W. Morse
9:00 am	<a href="#">WBS 1.3.5 Tracker</a>	E. Hungerford
9:30 am	<a href="#">WBS 1.3.6 Calorimeter</a>	P. Nemethy
10:00 am	COFFEE BREAK	
10:15 am	<a href="#">WBS 1.3.7 Cosmic Ray Shield</a>	J. Kane
10:35 am	<a href="#">WBS 1.3.8 DAQ &amp; Online Computing</a>	K. Kumar
10:55 am	<a href="#">WBS 1.3.9 Simulation &amp; Offline Analysis</a>	Y. Kolomensky
11:30 am	<a href="#">WBS 1.3.10 Installation &amp; Integration</a>	M. Hebert
11:45 am	<a href="#">WBS 1.3.11 MECO Project Office</a>	M. Hebert
12:00 pm	LOG WORKING LUNCH	
1:00 pm	<a href="#">WBS 1.4 AGS Project Overview</a>	P. Pile
1:45 pm	<a href="#">WBS 1.4.1 AGS/Booster</a>	K. Brown
2:15 pm	<a href="#">WBS 1.4.2 Switchyard</a>	A. Pendzick
2:45 pm	<a href="#">WBS 1.4.3 KOPIO</a>	C. Pearson
3:15 pm	COFFEE BREAK	
3:30 pm	<a href="#">WBS 1.4.4 MECO</a>	D. Phillips
4:00 pm	<a href="#">WBS 1.4.5 Project Administration</a>	P. Pile
4:15 pm	LOG Executive Session	
5:30 pm	Questions for RSVP Management	
6:00 pm	ADJOURN	

<b>Thursday, January 20, 2004</b>		
<b>Physics Building, Orange Room</b>		
8:30 am	Presentation of Answers to LOG Questions	
9:30 am	LOG Executive Session	
12:00 pm	LOG WORKING LUNCH	
1:00 pm	Closeout with RSVP Project Directors & Managers	
1:45 pm	ADJOURN	

Guidance Provided for the Review

Last updated January 18, 2005 by [Steve Kane](#).

Privacy and Security Notice

## **Appendix B**

### **Charge to the RSVP Laboratory Oversight Group RSVP Project Director's Review January 18-20, 2005**

The Laboratory Oversight Group (LOG) has the mission of providing internal review and oversight of the Rare Symmetry Violations Processes (RSVP) Project. The LOG is organized and chaired by the BNL Associate Laboratory Director of High Energy and Nuclear Physics (ALD-HENP) and provides its observations, comments and recommendations to the RSVP Project Director. Officers of the funding agencies may join the LOG reviews as observers and are copied on the review reports.

The subject of the January 18-20, 2005 Review will be a detailed assessment of the technical and cost estimate status of the project at the second level ( $L2 \equiv 1.x.y$ ) of Work Breakdown Structure (WBS). To facilitate this review, the managers of the RSVP Project are asked to fill in and provide to the LOG, a complete set of Review Status Sheets at WBS L2 that will facilitate this review's focus. Having supplied this basic status information, the oral presenters of the WBS L2 elements may provide very brief introductory comments of their own choosing, but will primarily respond to questions from the LOG members based on the material provided in the status sheets. This is a somewhat unconventional review plan but is designed to bypass the usual descriptive material that the LOG members can learn ahead of time from the status sheets plus other introductory material about the KOPIO, MECO and AGS projects that will be provided to them by the ALD and RSVP Project Office.

The results of the LOG members review will be communicated to the RSVP Project Management at an oral closeout following the review and in a written Review Report from the LOG supplied within two weeks of the review completion (February 3, 2005, COB).